Photon Detector R&D at IU for TallBo2 & 35 ton Test

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Objectives:

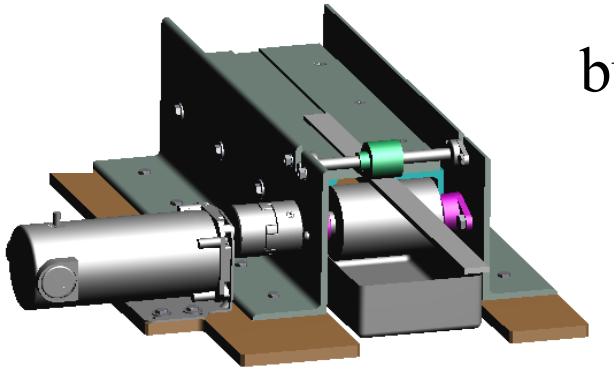
1. TallBo2 & 35 ton test: Test multiple light guide technologies
2. TallBo2: Test Argonne electronics with twisted-pair cables
3. 35 ton test: Test multiple light guide technologies;
   Test calibration scheme(s)

Light Guide Technologies:

- IU technologies
  - flash-heated bars with 35 coats of TPB and bis-MSB
  - cast acrylic bars with 1% TPB (Astra Products)
  - cast acrylic bars with 1.2% TPB (max concentration, commissioned)
  - cast acrylic bars with 1% bis-MSB (commissioned)
  - roller coated bars

Light Guide Technologies:

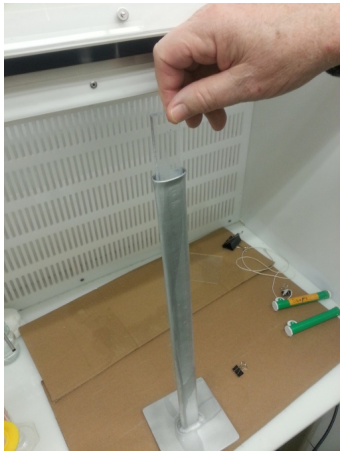
built!



- IU technologies
  - roller coated bars

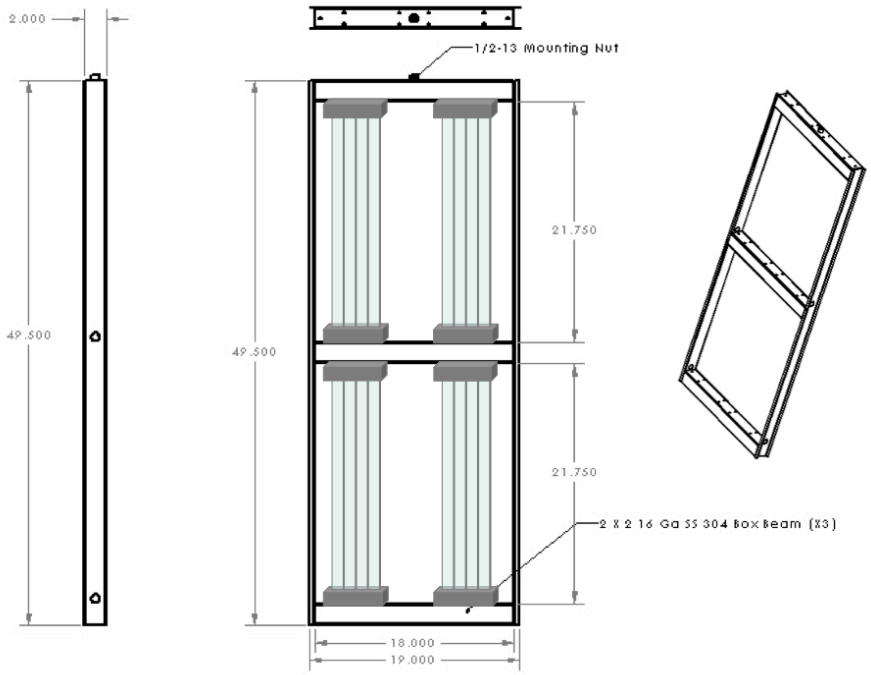
  (technology not yet ready, for TallBo2 run)

- MIT hand-dipped technology with TPB on acrylic blanks from IU



- CSU polystyrene extruded fiber technology with TPB
- LBNL cast polystyrene technology with embedded 1% TPB and 1% bis-MSB (Eljen)

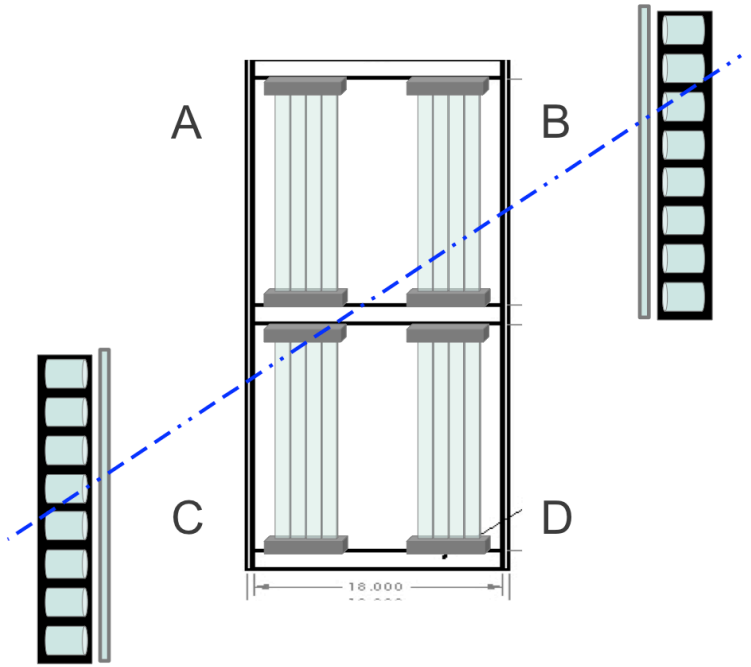
TallBo2



LAr dewar in PAB at Fermilab

- 6’ x 22”, 500 l capacity
- capacity for 4 paddles/16 light guides
- LAr recycling and purification system

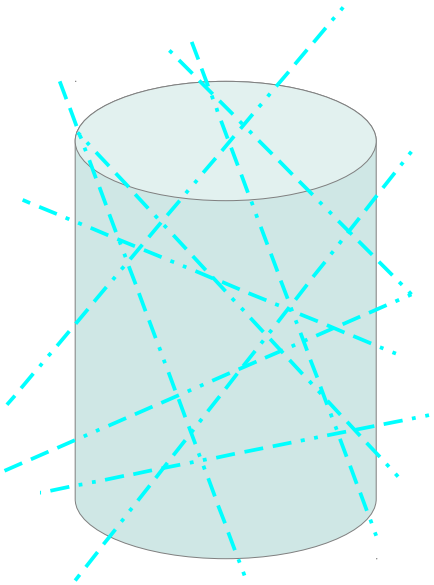
CREST hodoscope paddles to define cosmic track parameters



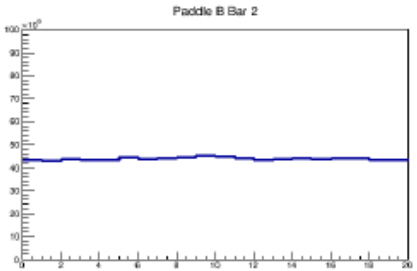
- Two 8 x 8 arrays of PMTs with BaF_2 crystals coated with TPB
- plastic scintillator paddles on both sides
- 4-fold coincidence trigger: 1 PMT + 1 paddle on each side

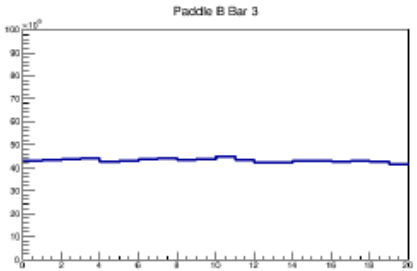
How do we test bars in TallBo? That is, how do we determine which bars function best?

"Free run" mode: self triggered, OR of all SiPMs in paddle

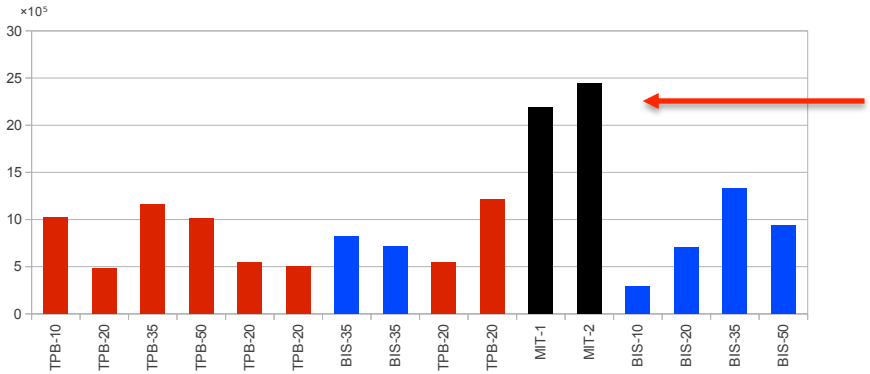


All bars see same distribution of scintillation photons from cosmics (MC of random bars in TallBo)





Results:



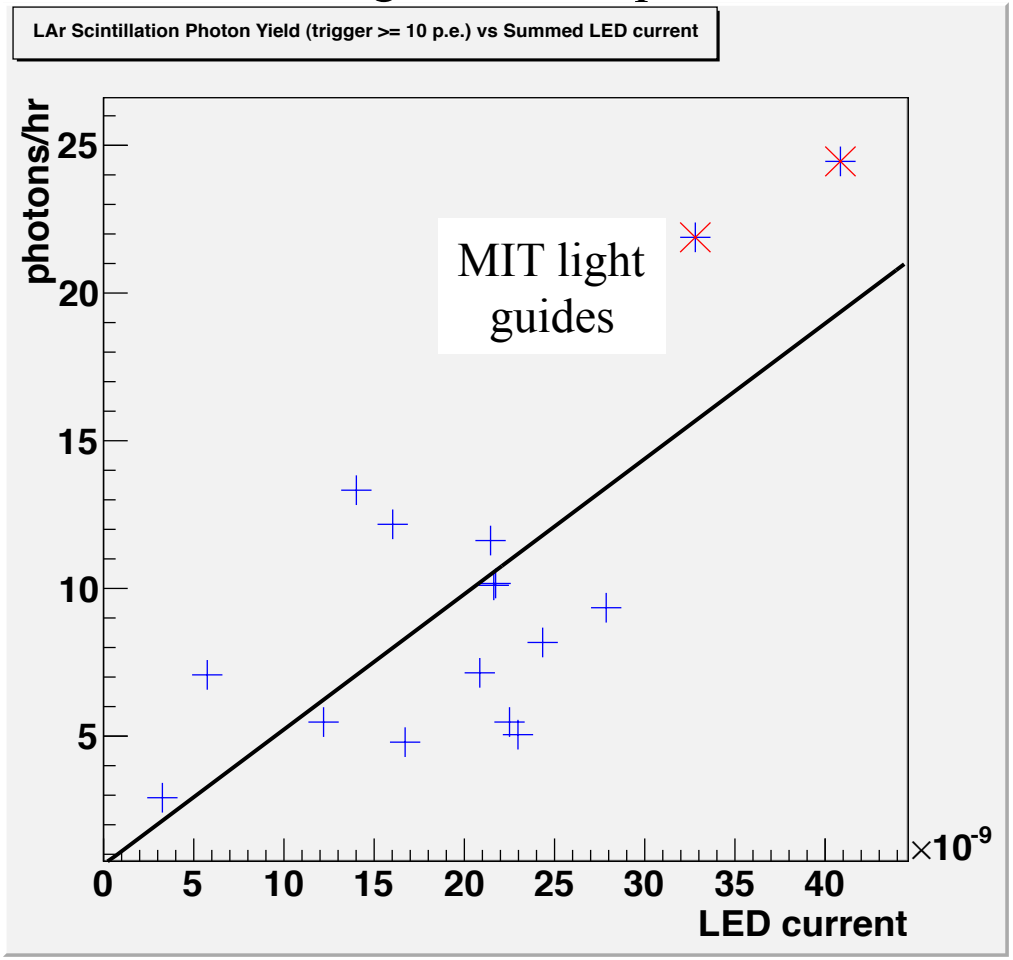
MIT bars are brightest in LAr

It is very time- and resource- intensive to test light guides in LAr

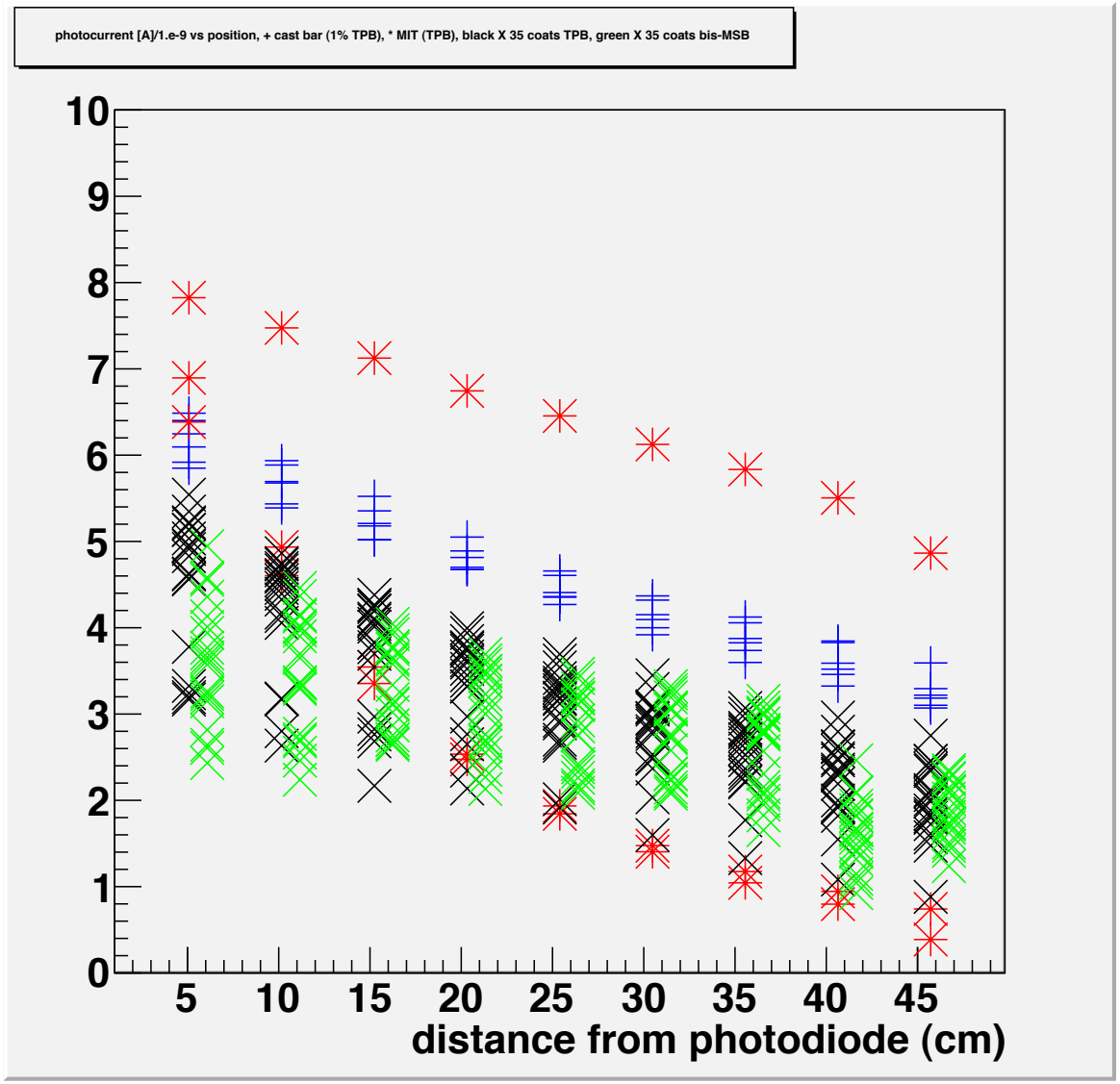
Test bars at room temperature at 245 nm in dark box

Dark Box with computer controlled LED travel viewed by SiPM

efficiency of bar in LAr correlated with integrated LED photocurrent

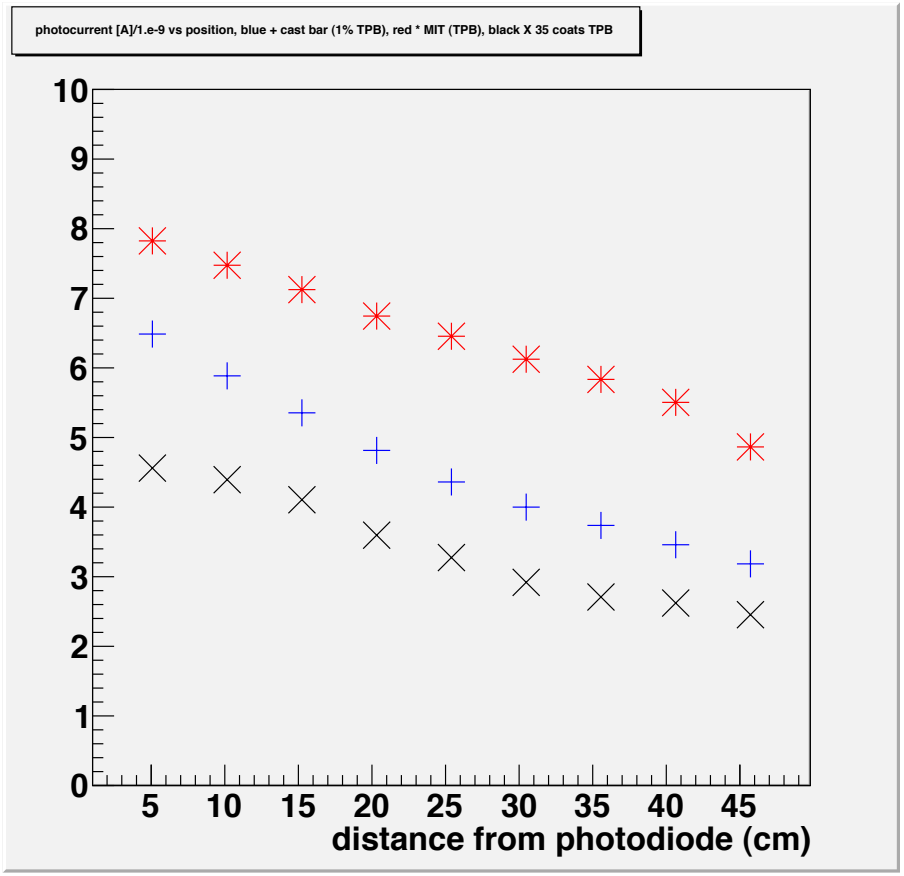


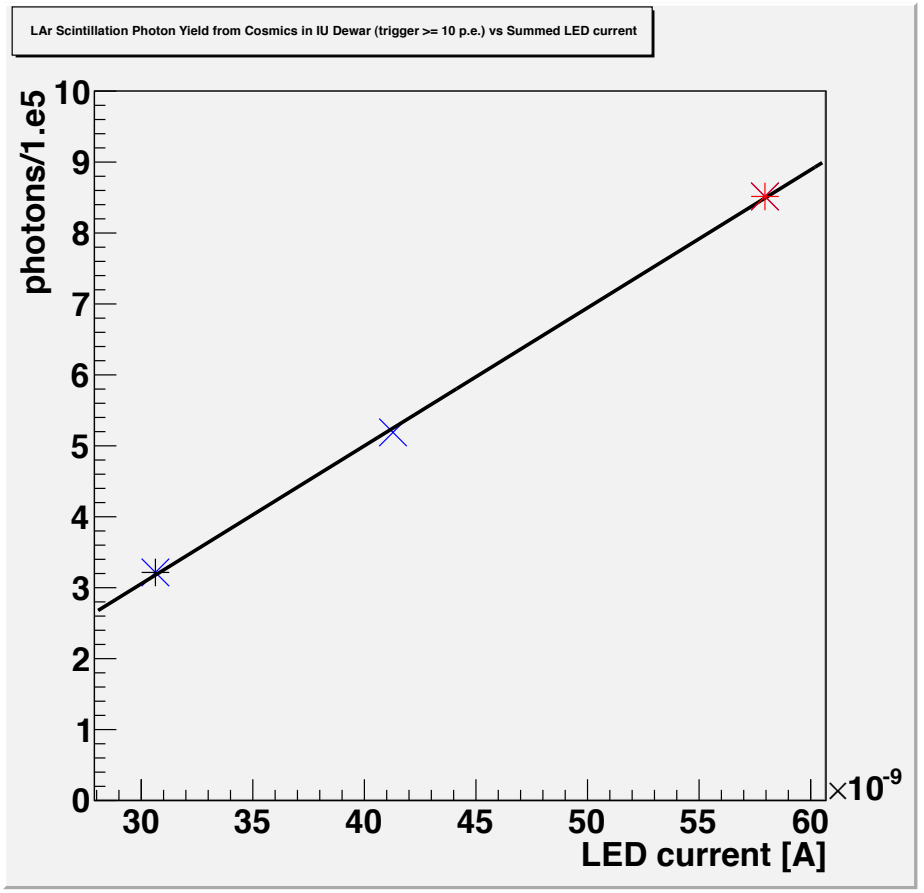
IU & MIT light guides measured at 245 nm in dark box



brightest light guides at 245 nm manufactured with 3 technologies

output at 245 nm correlates with LAr scintillation light from a “free run” in the IU dewar





Current schedule:

TallBo2: IU, MIT, CSU, LBNL technologies

- setup week of 2/24
- run weeks 3/3 & 3/10
- tear down/go home week of 3/17